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A mixed-methods study of the demographic and behavioural correlates of walking to a more distant bus stop

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ABSTRACT

Walking to more distant public transport stops is commonly promoted for physical activity gain.
We examined the uptake of, and reasons for, this behaviour and its correlates through a cross-sectional survey (n = 944) and independent interview study (n = 22). Quantitative analysis examined correlates of frequency of walking to more distant bus stops, including demographic variables, past week bus use, bus stop accessibility, and physical activity. Interviews explored reasons for engaging in this behaviour.
Of participants (38%) who had used the bus the previous week, 13% had walked to a more distant bus stop every/most times. Median walking and total physical activity were highest ($P = 0.003$) among this group (210 and 465 min/week, respectively) compared to those who did sometimes (150 and 260 min/week, respectively) or not at all (150 and 270 min/week, respectively). Among interview participants who engaged in this behaviour (n = 12), over half did so for physical activity gain, with the remaining being driven by other co-benefits. Many interviewees overlooked the physical activity benefit of this behaviour.
This novel study integrated quantitative and qualitative data and discovered those who walk to more distant public transport stops were generally more physically active than those who do not. While some users were aware of the health benefits, many did so for other reasons.

1. Introduction

Insufficient physical activity poses one of the most significant global threats to the sustainability of health care systems and the health and wellbeing of the world population. It is significantly associated with a wide range of diseases, including cardiovascular disease, type 2 diabetes, different types of cancer, stroke, depression and cognitive decline (Lautenschlager et al., 2008; Kyu et al., 2016; Rebar et al., 2015; Australian Institute of Health and Welfare, 2017; Brister, 2018), as well as all-cause mortality (O'donovan et al., 2017; Lear et al., 2017). The cost of physical inactivity was estimated at international (INT) $53.8 billion worldwide in 2013 (Ding et al., 2016), and AUD$1.5 billion in Australia in 2006–07 (Econotech, 2007). Despite recommendations that adults should engage in at least 150 min of moderate-intensity physical activity per week to be considered sufficiently active for health (World Health Organization, 2010), 31% of adults worldwide do not meet this recommendation (Hallal et al., 2012). In Australia, only 55.4% of adults were estimated to be sufficiently active for health in 2017–18 (Australian Bureau of Statistics, 2019). This figure was virtually stagnant between 1989 and 2011, at around 35–40% (Chau et al., 2017), suggesting that PA promotion messages, which have mainly focused on leisure-time activity, have not been effective. The targeting of other domains of physical activity, such as transport-related physical activity, is required.

Active commuting offers an accessible way to increase physical activity and has been found to be associated with lower risk of obesity and

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cardiovascular disease (Hamer and Chida, 2008; Flint et al., 2016). A systematic review found that users of public transport accumulate an additional 8–15 min of total physical activity per day due to more time spent in active commuting (Rissel et al., 2012), suggesting an important opportunity to promote physical activity via public transport use. While private motor vehicles are the predominant mode of transport in Australia, health promotion messages in Australia and internationally encourage current public transport users to exit a station/stop earlier or walk to a more distant station/stop to add minutes of incidental physical activity (Department of Premier and Cabinet, 2018; U.S. Department of Health and Human Services, 2017). However, the uptake of these messages is unknown. An additional knowledge gap is an understanding of the characteristics of those who do partake in this behaviour. This is important information, because it may provide insights for policymakers and service providers into who may require specific targeting to encourage others to walk to more distant stations/stops, and how this might best be done.

This study aimed to fill a knowledge and practice gap by identifying the number, demographic characteristics and other correlates of people who walk to more distant stops when using public transport, and their reasons for engaging in this behaviour. To the authors' best knowledge, this is the first study to investigate this specific aspect of active transport behaviour, using a combination of quantitative and qualitative methods to offer unique insights to guide the development of more effective health promotion messages to increase physical activity levels.

2. Materials and methods

2.1. Study design

This study used quantitative data from an online survey of Tasmanian adults (the 2017 Tasmanian Travel and Physical Activity Study) and qualitative data from an independent individual interview study conducted in 2018 with adults living in the capital city, Hobart (Sharman et al., 2019). The aim of the online survey was to understand the relationship between the travel behaviours of Tasmanians and physical activity and health, as well as people's attitudes, preferences and perceptions of public transport. The individual interview study was designed to explore behaviour related to transport use and physical activity among bus users in Hobart. Based on preliminary survey findings, questions about walking to/from a more distant bus stop were included in the qualitative study to enable deeper exploration of this behaviour. The study was designed in consultation with key stakeholders (an urban public transport provider, a city council and a state government department).

2.2. Study population and recruitment methods

Tasmania is an island state of Australia with a population of approximately 520,000 (Australian Bureau of Statistics, 2016), where almost half of its population resides in the Hobart region, with the remaining being found in regional areas (Australian Bureau of Statistics, 2017). Buses offer the only mode of public transportation in Tasmania. Public transport use comprises 3% of Tasmanian adults' primary mode of transportation to work (Australian Bureau of Statistics, 2011) and 4% of primary mode of transportation for trips of all purposes in the greater capital city of Hobart (Department of Infrastructure EaR, 2010). Tasmania is a poor performer on health outcomes compared to other Australian states and territories and has the lowest percentage of adults considered sufficiently active for health (52.5%) (Australian Bureau of Statistics, 2019).

For the quantitative and qualitative studies, participants were adults (≥18 years) living in Tasmania during the data collection periods (March to April 2017 for the survey and April to May 2018 for the individual interviews). Participants for both studies were recruited through convenience sampling methods, which included the dissemination of promotional materials via traditional and social media, professional networks and organisations, and flyers left in key locations. For the online survey, a link was also included in a concurrent University of Tasmania Staff and Student Travel Behaviour Survey (Lyth et al., 2017). For the individual interview study, men and those without a university qualification who had completed the survey study were purposively invited to be interviewed via email (n = 306), as these demographic groups were initially under-represented.

2.3. Procedure and sample size

Ethics approval was received from the Tasmania Social Science Human Research Ethics Committee for the quantitative survey on 10 February 2017 (H16327) and for the individual interviews on the 22 March 2018 (H17217).

Review of the information sheet and consent form were hurdle requirements before participating in either study. Participants of the online survey gave their informed consent by clicking the 'Agree' button before commencing the survey, and either in writing (for the face-to-face interviews) or verbally (which was audio-recorded, for the telephone interviews) for the interview study. One author (MS) conducted all interviews. No repeat interviews were conducted. At the end of the survey, respondents had the option of entering a draw to win one of five AUD$100 vouchers and all interview participants were entitled to a $20 bus voucher.

A total of 1355 respondents participated in the online survey, of which 411 were excluded. Reasons for exclusion included not answering any questions beyond the consent form (n = 16) and failure to complete all the mandatory questions (n = 248). A further 147 cases contained missing data on moderate-intensity and vigorous-intensity physical activity variables due to a systematic error in the survey design. Chi-square and Fisher's Exact tests were used to investigate the statistical associations between demographic factors and the missing and non-missing groups, with no significant associations found (Supplementary Table 1). The final sample included 944 participants.

Forty-four people expressed interest in participating in the interview study. A maximum variability sampling matrix guided purposive recruitment of participants to maximise diversity between participants, particularly regarding gender, education level and bus use. After review of the sample variation and data fit with the method and theoretical framework, it was agreed between authors MS and VC that saturation (i.e. no new information was being generated) had been achieved after 22 interviews and no further interviews were necessary.

2.4. Measures

2.4.1. Quantitative survey

2.4.1.1. Demographic variables. The online survey gathered data on 55 questions measuring demographic characteristics, physical activity behaviours and travel behaviours and attitudes. Demographic variables included: gender (man, woman or other); language spoken at home (English or other); current injury, illness, disability restricting physical activity (yes or no); age (18–24, 25–34, 35–44, 45+); employment status (working full-time hours, working part-time hours, not in the labour force or other); student status (studying full-time, not studying full-time); highest education level (low, medium or high); household composition (family with children under 18 years old living at home, couple without children under 18 years old living at home, group household, lone person or other); regular access to a car or motorcycle (yes or no); and self-reported general health (excellent/very good, good or fair/poor).

2.4.1.2. Physical activity variables. Physical activity was reported via the International Physical Activity Questionnaire – Short Form (IPAQ-SF) (IPAQ Research Committee, 2005). Participants reported the duration (minutes) and frequency (number of days) of walking, vigorous-intensity and moderate-intensity physical activity during the seven days preceding the survey. The physical activity summary measures 'walking minutes/week', 'total physical activity minutes/week' and a categorical physical activity score (low, moderate or high) were then derived using the IPAQ scoring protocol (IPAQ Research Committee, 2005).

2.4.1.3. Public transport behaviour variables. The online survey collected data on participants' walking duration from home to the nearest bus stop (categorical variable collapsed into 5 min or less, 6–10 min or >10 min) and frequency of bus use in the last seven days (categorical variable collapsed into did not take the bus, 1–4 times or 5 times or more). Participants who reported taking the bus were then prompted with a question asking whether they chose to walk to a more distant bus stop on any of those days. Responses were collapsed into did not walk to a more distant bus stop, sometimes walked to a more distant bus stop or walked to a more distant bus stop every/most times.

2.4.2. Qualitative interview

Participants were initially asked questions related to sociodemographic characteristics (gender, age, employment status, highest level of education, household composition, general health), physical activity (whether on average they met recommended Australian physical activity weekly targets of 150 min moderate or 75 min vigorous physical activity (Australian Government Department of Health, 2014)) and their average weekly morning bus use. While the interview schedule contained a range of questions related to transport and physical activity behaviour, in this manuscript we present only the findings relevant to questions asked about walking/not walking to/from a more distant bus stop. Participants were asked if they walked further than necessary when catching the bus, their reasons for walking/not walking further than necessary and whether they believed there was a health/physical activity benefit to walking further than necessary.

2.5. Analysis

2.5.1. Quantitative survey

Analysis of survey data was conducted using Stata SE 15.0 (StataCorp, TX, USA) and *P* values of <0.05 were considered statistically significant. Chi-square and Fisher's Exact tests (when cell sizes were <5) examined categorical correlates of walking to a more distant bus stop (demographic variables, walking duration from home to the nearest bus stop and categorical physical activity score). The Kruskal-Wallis test was used to examine continuous correlates of walking to a more distant bus stop (walking minutes/week and total physical activity minutes/week). Only bouts of physical activity lasting at least 10 min are captured by the IPAQ-SF instrument, therefore our aim is to describe physical activity levels of participants by categories of the outcome variable, rather than to examine whether walking to a more distant bus stop contributed to higher levels of physical activity.

2.5.2. Qualitative interview

Interview data were transcribed, anonymised and subsequently analysed thematically, facilitated by use of NVivo 11 (QSR International, Doncaster, Victoria, Australia). Firstly, each individual interview transcript was analysed by author MS progressing to analysis of the whole qualitative data set in order to expose overall themes and sub-themes. Themes were compared across gender. Regular discussion occurred within the research team regarding the emerging themes until there was agreement that the data had been comprehensively analysed and no new themes were emerging.

Transcripts, memos, email correspondence and meeting notes contributed to the audit trail during analysis. No participants requested to review or amend their transcripts and participants were not asked to provide feedback on the findings.

3. Results

3.1. Quantitative survey

Descriptive characteristics of the sample can be found in Table 1. Compared with the broader Tasmanian population, the following groups were over-represented in the survey sample: women (68% in this study vs. 52% of the broader population), people aged 18–44 (64% vs. 40%), those working at least part-time (76% vs. 50%), full-time students (23% vs. 5%), those with

Table 1
Characteristics of quantitative survey participants (n = 944) and individual interview participants (n = 22) in Tasmania in 2017.

Demographic variables	Survey sample % (n)	Interview sample % (n)
Gender		
Man	31.4 (296)	32 (7)
Woman	67.8 (640)	68 (15)
Other[a]	0.9 (8)	–
Age (years)		
18–24	18.3 (173)	9 (2)
25–34	23.4 (221)	14 (3)
35–44	22.3 (210)	46 (10)
45+	36.0 (340)	32 (7)
Employment status		
Working full-time hours	44.2 (417)	46 (10)
Working part-time hours	31.3 (295)	36 (8)
Not in the labour force	23.8 (225)	18 (4)
Other[b]	0.7 (7)	–
Student status		
Studying full-time	23.0 (217)	–
Not studying full-time	77.0 (727)	–
Highest education level[c]		
Low	22.5 (212)	5 (1)
Medium	24.8 (234)	14 (3)
High	52.8 (498)	82 (18)
Household composition		
Family with children <18yo living at home[d]	31.9 (301)	27 (6)
Couple without children <18yo living at home	26.1 (246)	18 (4)
Group household (adults living together)	20.0 (189)	18 (4)
Lone person	19.1 (180)	27 (6)
Other[e]	2.9 (28)	10 (2)
General health		
Excellent/very good	57.7 (544)	68 (15)
Good	30.4 (287)	18 (4)
Fair/poor	12.0 (113)	14 (3)
Language spoken at home		
English	97.5 (920)	–
Other	2.5 (24)	–
Regular access to a car or motorcycle		
Yes	77.4 (731)	
No	22.6 (213)	
Current injury, illness, disability restricting physical activity		
Yes	13.4 (126)	–
No	86.7 (818)	–
Physical activity variables		–
Continuous variables		
Minutes of walking/week, median (IQR)	150 (75–280)	–
Minutes of total physical activity/week, median (IQR)	300 (155–528)	–
Categorical score		
Low	23.9 (226)	–
Moderate	46.9 (443)	–
High	29.1 (275)	–
Public transport behaviour variables		
Walking duration from home to the nearest bus stop		
5 min or less	61.6 (581)	–
6–10 min	21.7 (205)	–
>10 min	16.7 (158)	–
Frequency of bus use in the last 7 days		
Did not take the bus	62.4 (589)	–
1–4 times	19.6 (185)	–
5 times or more	18.0 (170)	–
Walking to a more distant bus stop in the last 7 days, among bus users (n = 355)		
Did not walk to a more distant bus stop	66.5 (236)	–
Sometimes walked to a more distant bus stop	20.0 (71)	–
Walked to a more distant bus stop every/most times	13.2 (47)	–
Missing	0.3 (1)	–

[a] Includes 'transgender', 'prefer not to disclose', 'gender fluid' and 'non-binary'.
[b] Includes volunteers and unclear responses.
[c] Low = Year 12 or less; Medium = Trade/apprenticeship or Certificate/Diploma; High = University qualification.
[d] Includes 'one parent family'.
[e] Includes large families and multigenerational households, 'visitor only' and unclear responses.

a university qualification (53% vs. 15%) and English speakers at home (98% vs. 88%) (2016 Census of Population and Housing, 2016). Seventy seven percent of the sample had regular access to a car or motorcycle that they could drive or ride. Median walking time was 150 min/week and median total physical activity was 300 min/week. Twenty four percent of the sample did low levels of physical activity, 47% did moderate levels of physical activity and 29% did high levels of physical activity. Despite 83% of the sample residing within <10 min' walk from the nearest bus stop, only 38% of participants used the bus at least once in the seven days prior to the survey. Among those who had used the bus in the previous seven days (n = 355), 13% walked to a more distant bus stop every or most times, but two thirds walked only as far as the nearest bus stop.

Language spoken at home was the only demographic correlate of walking to a more distant bus stop (Table 2). While this finding was statistically significant, it must be interpreted with caution due to the very small number of participants who did not speak English at home (n = 15).

Median minutes of walking and total physical activity per week were significantly higher among those in the sample who had walked to a more distant bus stop every/most times (210 min/week and 465 min/week, respectively) than those who reported doing it sometimes (150 min/week and 260 min/week, respectively) or not doing it at all (150 min/week and 270 min/week, respectively). Those whose physical activity was categorised as high reported that they more frequently walked to a more distant bus stop (22%) than those who were categorised as moderate (11%) and low (7%). While the direction and magnitude of the association remained the same, this result was no longer statistically significant ($P = 0.17$) when we excluded those with injury, illness or disability that restricted physical activity (data not shown).

Walking duration from home to the nearest bus stop had no relationship with walking to a more distant bus stop. In a sensitivity analysis, dichotomising the outcome between those who walked every/most/sometimes and those who did not walk to a more distant bus stop and excluding those with injury, illness or disability that restricted physical activity did not significantly change the results (data not shown).

3.2. Qualitative interviews

All interviewed participants were weekly bus users. This group were predominantly women, most were aged between 35 and 77 years old, working, highly educated, living with a partner and reporting good health (Table 1). Most participants reported meeting Australian weekly recommended physical activity targets of at least 150 min of moderate-intensity physical activity. The average interview duration was 25 min (range 16–38 min). Interviews revealed a range of reasons for walking or not walking to/from a more distant bus stop with physical activity/health-related reasons being predominantly discussed by participants. The key findings are summarised below. All quotes cited are from participants, with gender and age noted.

3.2.1. Reasons for not walking to/from a more distant bus stop

Of the 22 participants, 10 did not walk to/from a more distant bus stop. Six of these 10 participants indicated that walking further was unnecessary because they were already doing sufficient physical activity. Three women suggested that it was an adequate walk to or from the bus stop anyway (e.g. 10–15 min) so walking to/from a more distant bus stop was unnecessary. Other reasons cited for not walking to/from a more distant bus stop included time constraints, injury, traffic, pollution and unfamiliarity with other bus routes or timetables. Additionally, one participant who preferred to use the most convenient bus stop said "…I don't think walking will do a lot of help in terms of wellbeing…it hurts your knees" (man, 27 years). Three participants who did not walk to/from a more distant bus stop also said that they did not meet recommended weekly physical activity targets.

3.2.2. Reasons for walking to/from a more distant bus stop

Among the 12 participants who did walk to/from a more distant bus stop, half (all women and all meeting recommended physical activity targets) said they did so specifically for health and/or physical activity gain, "…that's the only reason I'd get off early is to try to get a bit of walking in" (woman, 32 years) and "…the more walking the better" (woman, 35 years). Two men said that they were aware of the health and/or physical activity gain from walking to/from a more distant bus stop, but their main reason for doing so was to catch a bus on a different bus route that better suited their schedule. One participant who said that she walked further than necessary if time allowed "…didn't actually believe…it was going to be of any physical benefit, because it was only a 10-minute, 15-minute walk" (woman, 37 years). Other reasons given for walking to/from a more distant bus stop included avoiding crowded bus stops, minimising time spent on a crowded bus, not wanting to wait unnecessarily at a bus stop, enjoyment of walking on a nice day and getting some fresh air. Of the six participants who walked to/from a more distant bus stop for reasons other than for physical activity/health benefit, two reported that they did not meet weekly recommended physical activity targets.

4. Discussion

This study aimed to fill a knowledge and practice gap by describing the uptake of walking to/from more distant bus stops, reasons for doing so, and correlates of this behaviour. Less than 15% of bus users walked to a more distant bus stop every or most times in the preceding week. Walking and total minutes of physical activity per week were both significantly higher among those who had walked to a more distant bus stop every or most times, compared to those who had done this sometimes or not at all. Although some people adopted this behaviour specifically for health and/or physical activity gain, there were other co-benefits that often drove this behaviour, such as avoiding crowded bus stops and minimising time spent on a crowded bus.

The findings suggest that public transport use represents a potentially important public health opportunity. Access to public transport stops/stations is a critical determinant of usage, although there is no clear consensus on the optimal distance for stops/stations to encourage walking, which varies according to the location, circumstances, transport mode and purpose (van Soest et al., 2020). Given that 62% of the sample lived within a 5-minute walk and 83% lived within a 10-minute walk of a bus stop, access to public transport does not appear to be a critical barrier in this sample, encouraging public transport use appears feasible for a large proportion of this population, and doing so could have a substantial positive impact on physical activity levels. For instance, if those living a 5-minute walk from a bus stop chose to do so on the way to and from work 3 days per week, an additional 30 min of physical activity would be added to their week. For bus users, promoting walking to a further bus stop would increase physical activity levels even further. In addition, the findings suggest that health promotion messages that integrate physical activity gains with other co-benefits for adopting this behaviour may broaden appeal to a wider audience (e.g. walking to a more distant public transport stations/stop can help accumulate more physical activity and avoid crowded bus stops, all while getting some fresh air). Urban planning and public transport providers may also consider incorporating messages related to the health benefits of public transport as a method for enticing greater public transport use. We are unaware of other studies that have examined the physical activity levels of those who walk to more distant stations/stops to catch public transport, as well as their reasons for engaging in this behaviour, so comparison with other work is not possible.

Although some survey participants indicated that they chose to walk to a more distant bus stop for health/physical activity gain, the interview findings revealed a lack of awareness of the health benefits of accumulating small amounts of physical activity. Current physical activity recommendations indicate no minimum duration for bouts of physical activity for health gain, and in fact explicitly encourage adults to 'get off the bus a stop earlier and walk the rest of the way' because 'every bit counts' (Department of Premier and Cabinet, 2018). Our findings demonstrate a mismatch between physical activity recommendations and perceptions among some participants, although awareness of messaging of physical activity was

Table 2
Correlates of bus users' walking to a more distant bus stop (n = 354) in Tasmania in 2017.

Demographic variables	Walked to a more distant bus stop % (n)			*P*-value[a]
	Walked every/most times	Walked sometimes	Did not walk	
Gender				0.253
Man	17.0 (19)	21.4 (24)	61.6 (69)	
Woman	11.4 (27)	19.0 (45)	69.6 (165)	
Age (years)				0.958
18–24	13.4 (13)	17.5 (17)	69.1 (67)	
25–34	11.9 (10)	23.8 (20)	64.3 (54)	
35–44	15.5 (11)	19.7 (14)	64.8 (46)	
45 +	12.8 (13)	19.6 (20)	67.7 (69)	
Employment status				0.920
Working full-time hours	11.6 (15)	20.2 (26)	68.2 (88)	
Working part-time hours	11.9 (12)	19.8 (20)	68.3 (69)	
Not in the labour force	14.9 (18)	19.8 (24)	64.4 (76)	
Student status				0.220
Studying full-time	15.6 (19)	23.8 (29)	60.7 (74)	
Not studying full-time	12.1 (28)	18.1 (42)	69.8 (162)	
Highest education level[b]				0.388
Low	10.9 (12)	17.3 (19)	71.8 (79)	
Medium	18.8 (13)	17.4 (12)	63.8 (44)	
High	12.6 (22)	22.9 (40)	64.6 (113)	
Household composition				0.540
Family with children <18yo living at home[c]	11.2 (10)	20.2 (18)	68.5 (61)	
Couple w/o children <18yo living at home	11.0 (9)	17.1 (14)	72.0 (59)	
Group household (adults living together)	10.0 (8)	25.0 (20)	65 (52)	
Lone person	18.4 (16)	18.4 (16)	63.2 (55)	
Language spoken at home				0.008[d]
English	12.4 (42)	19.5 (66)	68.1 (231)	
Other	33.3 (5)	33.3 (5)	33.3 (5)	
Regular access to a car or motorcycle				0.309
Yes	10.9 (20)	19.1 (35)	70.0 (128)	
No	15.8 (27)	21.1 (36)	63.2 (108)	
General health				0.187[d]
Excellent/very good	15.6 (31)	19.6 (39)	64.8 (129)	
Good	12.6 (14)	17.1 (19)	70.3 (78)	
Fair/poor	4.6 (2)	29.6 (13)	65.9 (29)	
Current injury, illness, disability restricting physical activity				0.583
Yes	8.3 (4)	20.8 (10)	70.8 (34)	
No	14.1 (43)	19.9 (61)	66.0 (202)	
Physical activity variables				*P*-value[a]
Continuous variables				
Minutes of walking/week, median (IQR)	210 (150–350)	150 (90–210)	150 (75–280)	0.003[e]
Minutes of total physical activity/week, median (IQR)	465 (250–760)	260 (140–435)	270 (140–480)	0.003[e]
Categorical score				0.036
Low	6.9 (6)	21.8 (19)	71.3 (62)	
Moderate	11.4 (19)	21.0 (35)	67.7 (113)	
High	22.0 (22)	17.0 (17)	61.0 (61)	
Public transport behaviour variables				*P*-value
Walking duration from home to the nearest bus stop				0.932[d]
5 min or less	12.5 (30)	20.8 (50)	66.8 (161)	
6–10 min	14.8 (13)	18.2 (16)	67.1 (59)	
>10 min	16.0 (4)	20.0 (5)	64.0 (16)	

[a] Chi-square test, unless otherwise stated.
[b] Low = Year 12 or less; Medium = Trade/apprenticeship or Certificate/Diploma; High = University qualification.
[c] Includes 'one parent family'.
[d] Fisher's exact test.
[e] Kruskal-Wallis test.

not specifically asked about in either study. Given that adults with high education levels were overrepresented in the interview sample, it is possible that the reach of this message in the wider community is even lower. This suggests the need for improved public health messaging around physical activity recommendations and the associated health benefits supported by impact evaluation.

We were unable to identify any sociodemographic characteristics that differentiated those who had walked to a more distant bus stop from those who had not, potentially representing a physical activity promotion opportunity with broad appeal. The increase in incidental physical activity that potentially results from a change in transport-related behaviour could particularly benefit groups in the population at risk of insufficient physical activity, such as women, who show lower levels of engagement with leisure-time physical activity (Bauman et al., 2001; Trost et al., 2002). Further research that tests the feasibility and appeal of messages (e.g. with a health focus) to promote bus use broadly and walking to/from a more distant bus stop specifically across different demographic groups is warranted. Urban and transport planners should also consider the important health benefits of physical activity when designing public transport systems.

4.1. Study limitations and strengths

This study had several limitations. Although there was heterogeneity in the demographic characteristics, and physical activity and public transport

behaviours of survey participants, comparison with population level data showed that many groups were over-represented in the sample. The study was also conducted in a regional, low-density population with one mode of public transport. Generalisations to the wider population and higher-density urban settings may therefore be limited. Questions about public transport use and physical activity related to the past week may not reflect usual behaviour, and self-reported physical activity could have been misreported. Although we found that walking to a more distant bus stop was associated with greater time spent in walking and total physical activity, we cannot ascertain whether this behaviour directly contributed to these higher physical activity levels, as the walking may have been accumulated for other purposes such as leisure, work or domestic activities, or may not have been captured by the IPAQ if the bout was for <10 min. There may have also been other characteristics that were not measured, such as income, that may be correlated with public transport behaviour. The cross-sectional nature of the survey limits inferences about causality, meaning that it is possible that those who are already very active may be more inclined to choose to walk to a more distant bus stop. Further, while the interviews asked about walking 'to' and 'from' a more distant bus stop, the survey only asked about walking 'to' a more distant stop, potentially underrepresenting the prevalence of this aspect of behaviour. Strengths of this study include the large sample size of the survey, the focus on a novel area of investigation (i.e. choosing to walk to a more distant bus stop), and the combination of quantitative and qualitative methods that provide a unique depth and breadth of findings into this underexplored topic.

5. Conclusion

Adults who more often walk to more distant bus stops are generally more physically active than those who do not. While the cross-sectional nature of this study limits the ability to make causal inferences, those who reported more frequently walking to a more distant bus stop showed higher levels of physical activity, especially walking. This behaviour was relatively evenly distributed across sociodemographic characteristics, suggesting broad potential for this approach. Not all bus users were aware that even small increases in walking associated with public transport use are beneficial, suggesting that current health promotion messages may be having limited impact. The health benefits of public transport use, as well as the co-benefits of walking to more distant stops, such as avoiding overcrowding on vehicles and at stops, may warrant consideration for inclusion in health promotion messages aiming to increase physical activity. Given the lack of sociodemographic correlates of walking to a more distant bus stop, health promotion messages that incorporate some of the co-benefits of walking to more distant public transport stops have the potential to benefit all groups in society. Further research to better understand who chooses to walk to more distant bus stops in higher-density urban environments with multiple public transport modes is warranted.

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Declaration of competing interest

None to declare.

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